

Coatings
Corrosion
Fracture and Mechanical Testing
High Temperature Mechanical Properties
Hydrogen Production and Storage Materials
Hydrogen Separation Materials
Irradiation
Materials Validation
Microstructure and Physical Properties
Modeling
Neutron Radiography
Nondestructive Evaluation
Post-irradiation Examination
Synthesis and Processing of Novel Materials
Welding and Joining
X-Ray Radiography

Corrosion

Capabilities/Facilities

Immersion, crevice, U-bend, nanoindentation/scratch/impact, tensile/compression testing; slow-strain-rate fatigue testing; electrochemical, scanning probe, AC impedance. Aqueous and non-aqueous corrosion testing procedures, supercritical fluid environments, very high temperature capabilities, microbial systems, and oxidation studies. Cyclic environmental chambers, UV chamber, freeze-thaw chamber. Testing equipment includes instrumentation required for most American Society for Testing and Materials standardized methods and thermogravimetric analysis. Advanced capabilities include many in-situ electrochemical imaging probes (scanning electrochemical microscopy, multi-electrode array micros-

copy, and scanning reference electrode technique), three scanning probe microscopes, and an instrumented mechanical testing platform (nano-hardness, scratch, and impact testing), and extensive materials characterization capabilities.

Fuel Assembly and Storage Building and Materials and Fuels Complex Engineering Development Laboratory. Molten salt furnaces and alkali metals experiment glovebox.

Materials

Composites, coatings, concrete, engineering alloys, complex intermetallics, ceramics, thermal spray coatings, weldments, polymers, ceramic and metallic waste forms and nuclear fuel.

Scientific/Engineering

Issues

Identification and quantification of corrosion potentials and mechanisms; environmental degradation potentials; fundamental localized corrosion studies; long-term corrosion of Ni-Cr-Mo alloys, Ti and Al alloys; localized corrosion in heat affected zone of welds; waste form leach rate.

Staff

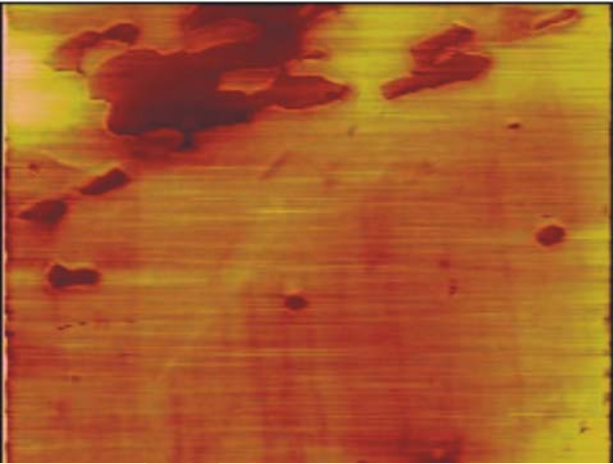
P.J. Pinhero, T.E. Lister, D.M. Ginosar, A.K. Wertsching, T.L. Trowbridge, T.S. Yoder, B.C. Norby, R.E. Mizia, B.A. Hilton, D. Janney, D.D. Keiser, J-F. Jue, I. Glagolenko, P. Medvedev and E. Loewen.

Recent Projects

Continued investigation of Local Corrosion in Alumi-

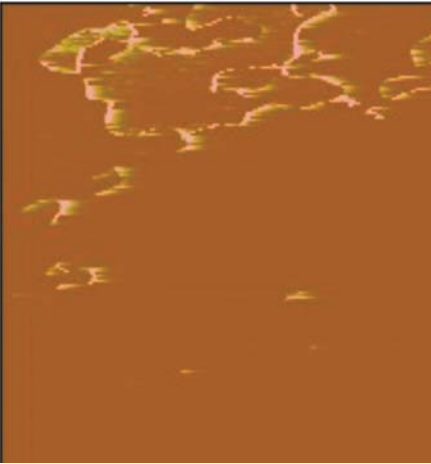
Topography

Topography

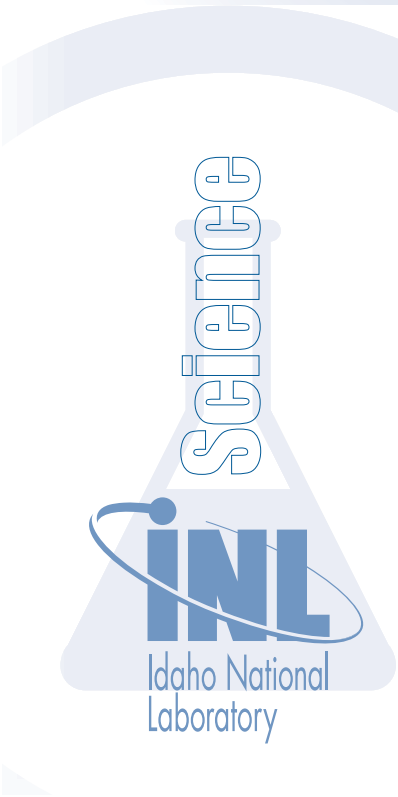


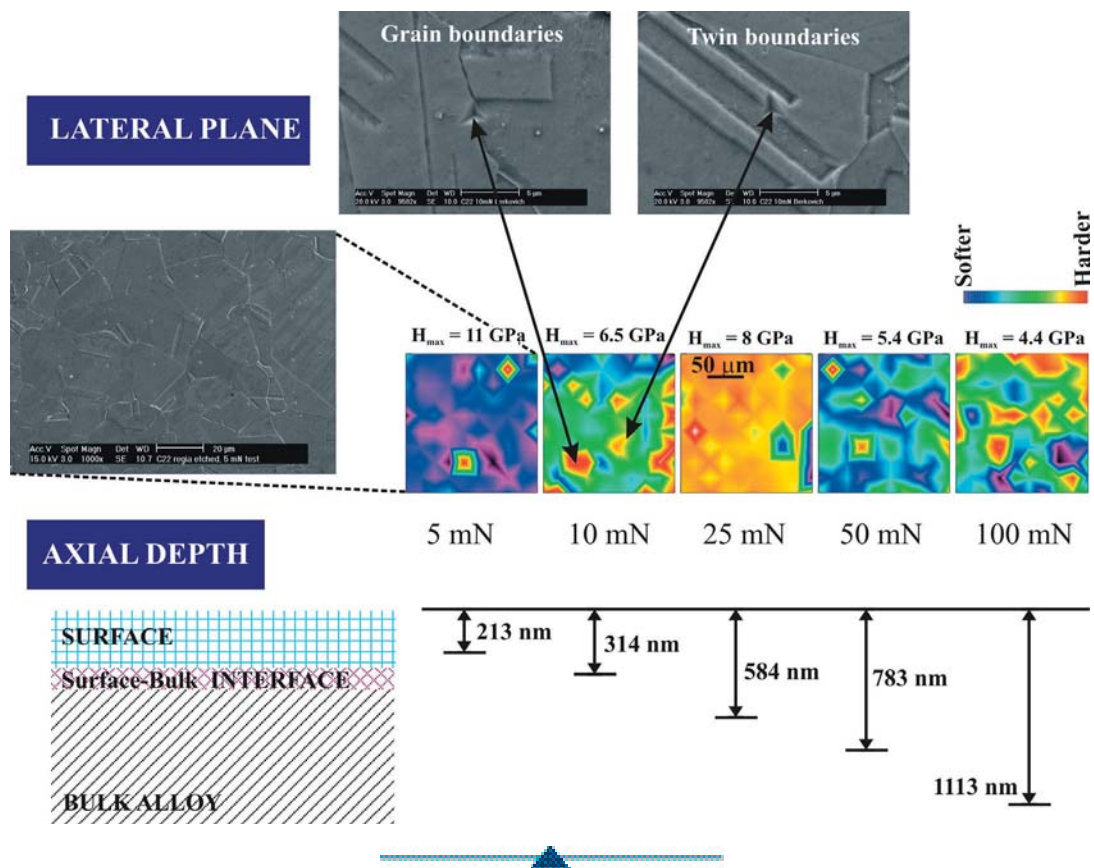
Conductivity

Conductivity



Ni-Cr-Mo-Gd specimen imaged in air with conductivity atomic force microscopy at a bias of 10 mV.





Nanoindentation (10 x 10 array) on etched specimen of Alloy 22 (Ni-Cr-Mo-W) showing localized variations in-plane and as function of depth.

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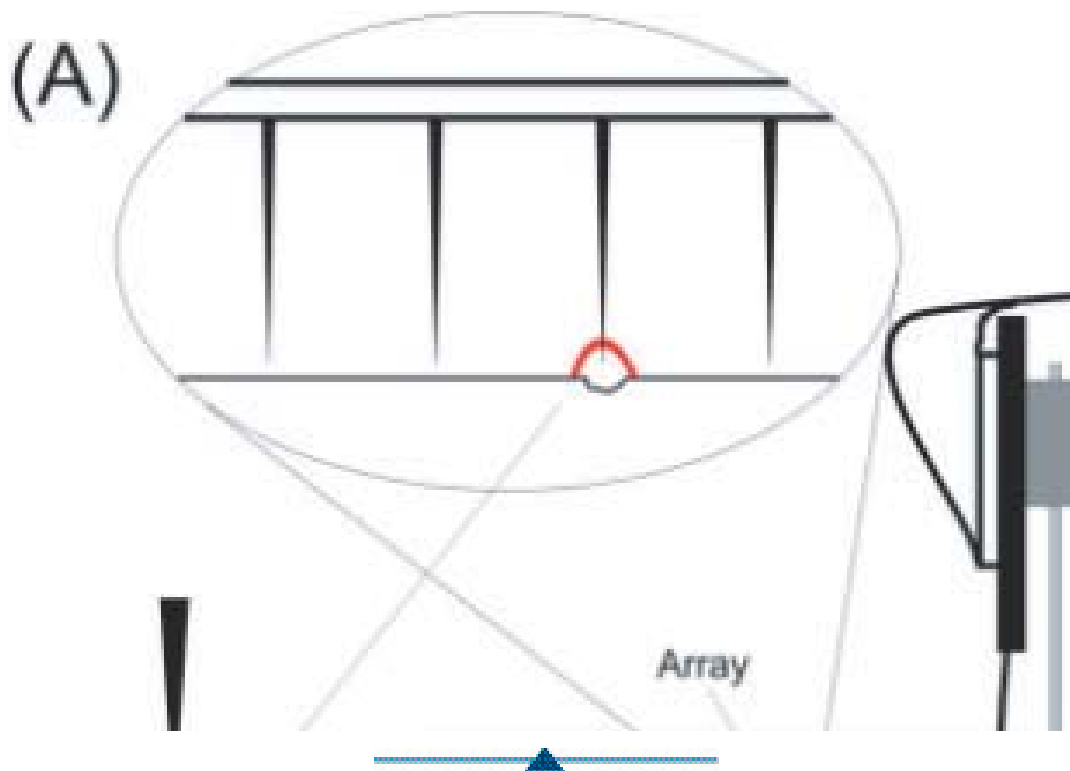
- num Alloys, DOE Office of Basic Energy Sciences, Center for Synthesis and Processing
- Biocorrosion of Spent Nuclear Fuel Cladding Materials, DOE Office of Environmental Management
- Neutron Poison Alloys for Yucca Mountain, DOE, Nuclear Materials Focus Area
- Development of Ni-Cr-Mo-Gd for Fuel Canister Insert, DOE National Spent Nuclear Fuel Program
- Corrosion of Borated Nickel Sprayed Coatings,

- DOE Small Business Innovation Research
- Lead-Cooled Fast Reactor, Laboratory-Directed Research and Development
- Fast Gas Reactor corrosion studies, DOE Office of Nuclear Energy
- Development of Real Time Electrochemical Imaging Instrumentation, Laboratory-Directed Research and Development
- INTEC Tank Farm Corrosion Evaluation
- Corrosion Mechanisms in Advanced Zr Alloys, DOE Nuclear Energy Research Initiative

Collaborations

- University of Utah, Prof. Henry White
- The Ohio State University, Prof. Rudy Buccheitt
- Sandia National Laboratory, Dr. Charlie Robino, Dr. F.D. Wall
- Brookhaven National Laboratory, Dr. Hugh Isaacs
- University of Western Ontario, Prof. David Shoosmith
- Lawrence Livermore National Laboratory, Dr. Frank Wong
- Lehigh University, Prof.

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Microelectrode array microscope (MEAM) for imaging real-time dynamics of aqueous localized corrosion. (A) Diagram of MEAM, (B) total specimen current, (C) current transient at one element, (D) transient of dynamic events shown in the images (E).

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- John DuPont
- Pacific Northwest National Laboratory, Dr. Russ Jones
- Powdermet, Inc., Euclid, OH, Dr. Andrew Sherman
- Southwest Research Institute and Massachusetts Institute of Technology, Prof. I. Hwang, on national security programs
- Westinghouse and Pennsylvania State University on corrosion of Zr cladding
- Texas A&M University on development of corrosion-resistant high thermal conductivity inert fuel matrices

- Argonne National Laboratory - Chicago

Publications

“Electrochemical Deposition and Re-oxidation of Au at Highly Oriented Pyrolytic Graphite. Stabilization of Au Nanoparticles on the Upper Plane of Step Edges,” C.S. Boxley, H.S. White, T.E. Lister and P.J. Pinhero, *Journal of Physical Chemistry B*, Vol. 107, p. 451, 2003.

“Guide to Metallic Corrosion” P.J. Pinhero, chapter in *Smithells Metals Reference Book*, W.F. Gale and T.L. Totemeier, eds. in press.

“Development of Corro-

sion Resistant, Neutron Absorbing Structural Material,” W.L. Hurt, R.E. Mizia, T.E. Lister, P.J. Pinhero, C.V. Robino and J.N. Dupont, *American Nuclear Society, 10th International High-Level Radioactive Waste Management Conference*, March 30-April 3, 2003.

“Analysis of Local Defects in Surface Films on Commercial Alloys Using Conductive Atomic Force Microscopy (C-AFM),” P.J. Pinhero, T.E. Lister, T.L. Trowbridge and R.E. Mizia, *NACE 2003*, *Continued on next page*

For more information

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March 16–20, 2003, San Diego, CA.

“Development of an Electrochemical Noise Surveillance System for Determining Compliance of INEEL High Level Waste Tanks to Corrosion Standards,” P.J. Pinhero, T.E. Lister and R.E. Mizia, *NACE 2003*, March 16–20, 2003, San Diego, CA.

“Microstructure and Corrosion Performance of a Neutron Absorbing Ni-Cr-M-Gd Alloy,” R.E. Mizia, T.E. Lister and P.J. Pinhero, *NACE 2003*, March 16–20, 2003, San Diego, CA.

“In Situ Imaging of Corrosion Events in Austenitic Steels by Scanning Electrochemical Microscopy,” T.E. Lister and P.J. Pinhero, *NACE 2003*, March 16–20, 2003, San Diego, CA.

“The Effect of Localized Electric Fields on the Detection of Dissolved Sulfur Species from Type 304 Stainless Steel Using Scanning Electrochemical Microscopy,” T.E. Lister and P.J. Pinhero, *Electrochimica Acta*, Vol. 48, p. 2371, 2003.

“Corrosion of Thermal Spray Hastelloy C-22 Coatings in Dilute HCl,” T.E. Lister, R.N. Wright, W.D. Swank, P.J. Pinhero and R.E. Mizia, *Journal of Thermal Spray Technology*, Vol. 11, p. 530, 2002.

“Scanning Electrochemical Microscopy Study of Corrosion Dynamics on Type 304 Stainless Steel,” T.E. Lister and P.J. Pinhero, *Electrochemical and Solid State Letters*, Vol. 5, no. 11, p. B33, 2002.

“In-Vivo Atomic Force Microscopic Imaging of Surface Proteins Within *Deinococcus Radiodurans*,” T.E. Lister and P.J. Pinhero, *Langmuir*, Vol. 17, p. 2624, 2001.

“Surface Oxidation of a Quasicrystalline Al-Cu-Fe Alloy: No Effect of Surface Orientation and Grain Boundaries on the Final State,” P.J. Pinhero, J.W. Anderegg, D.J. Sordet, T.A. Lograsso, D.W. Delaney and P.A. Thiel, *Journal of Materials Research*, Vol. 14, p. 3185, 1999.